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IRRIGATION PROBLEMS, PRACTICES AND ADVISORY WORK IN ISRAEL

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IRRIGATION PROBLEMS, PRACTICES AND ADVISORY WORK IN ISRAEL

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- - No man may waste a drop of water that another man may turn into bread.....(attributed to Brigham Young).

Throughout the world, huge and magnificent water projects for irrigation are designed and constructed at fabulous sums of money. Some of the best engineers and most experienced personnel are employed by government, public and private agencies to carry out surveying, investigations, planning, designing, construction and operation of such irrigation projects as dams, canals, pumping stations etc.

Both in developed and less developed areas the large projects attract the attention and sympathy of the state and the public, as ways and means by which the standard of living can be raised as a result of higher crop yields under irrigation, as compared with dry farming. However in many cases there is a sharp dividing line between the irrigation project which includes the main hydraulic features and between the system of water application in the field. The actual field irrigation is left to the farmer himself with the confidence and satisfaction that the task has been fulfilled, as long as the water has reached the boundaries of the farm in ample quantities and quality. The science, or rather the "art", of field irrigation is given little attention in funds and interest as compared with the effort put in the development of water resources and its diversion and conveyance to the field.

In many cases the discharge of canals and pipe lines exceeds 3 to 5 times the water requirements of plants, due to lack of reliable information of water consumption by plants and the uncertainty in determining and controlling the water application efficiency in the field. This, inturn involves greater and extra investments and expenditures in constructing the irrigation scheme. In other instances, mostly in cases of extreme water shortage, the irrigation system is sometimes so designed that it does not meet the field water requirements and a decrease in crop yield is expected as a result.

In most irrigated lands, some attention is paid and effort is made to advance the the science of irrigation in experimental stations. Although plant, soil and hydraulic scientists realize the importance and role which proper irrigation plays in the yield and quality achievements and in the long term conservation of soil to prevent salinity and water loging; only a small part of the knowledge and experience gained in the research stations is utilized by the planners and transferred to the farmers.

Irrigation in itself is only one of the agricultural factors which determine the yield level, but it is a very decisive limiting factor whenever water is applied in measure or when water is short.

In both cases water has to be applied intelligently in order to make the best use of it.

Experienced and good farmers throughout the world believe that "the more water the better" for almost all crops. After thorough examination of this conception it seems to me that its origin is in the usually low efficiency of water application in the field which involves larger amounts of water per application and more frequent irrigations as well.

There are two main categories of plants as far as the importance of irrigation is concerned. The first group consists of plants which can not grow or even exist under dry conditions without the addition of artificial irrigation. In our country these will be the evergreen subtropical plants such has citrus, bananas, avocado and the like. The second group consists mainly of field crops and fruit trees which can exist and grow even under dry conditions but their growth and yield level are dependent and are a function of the availability of moisture in the root zone.

The role of irrigation for the first category is to provide ample moisture in the root zone during the dry season needed to obtain the highest possible yields and best quality of fruit. The role of irrigation in the second category is more complicated in this respect, since it involves the economic consideration of the best allocation of water in order to obtain the highest net income per unit water.

In a given area, cotton can be irrigated two, three, four or five times during the season and in each case the yield per unit area may will be a function of the no. of irrigations. Thus, the plot receiving four or five irrigations will yield more than that of three irrigations and the plot receiving only two irrigations will probably give the lowest yield per unit area. However, if we have at our disposal only so much water per season and the developed land is not a limiting factor; a thorough analysis, based on experimental work and economic considerations, must be made in order to decide how many irrigations should each plot be given in order to obtain the highest income per the total amount of water at our disposal.

In our country which consists of arid and semi-arid areas we face some overall irrigation limitations which must be taken into consideration when developing new lands for irrigation.

(a) Shortage of water:

In order to supply the necessary agricultural products for the ever increasing local population and at the same time produce valuable agricultural products for export such as citrus; it is necessary to utilize all available sources of water. This is turn creates a problem of overall shortage of water both for the urban and the rural population. The individual farm or farmer is alloted only a given quantity of water per year according to the region, type of crop and size of farm. Irrigation norms for crops are established and water rationing is put into effect in almost all agricultural regions.

(b) High total cost of water:

Water is a very expensive commodity in our country. If we combine the price of water the farmer has to pay at the head valve and the amortization on irrigation installation and equipment, with the labor cost for irrigation - the cost of water may well amount to 0.10 I.L. per 1 m3 in most regions. If the average amount of water applied per Ha. per year is about 6500 m3, the total cost of water per Ha. would then be about 650 I.L. or app. $215. This high cost comprises a relatively high percent of the total production cost of many crops.

In citrus up to 15%
In cotton up to 20%
In ground nuts up to 25%
In corn up to 30%

(c) Soil, water and climatic limitations:

When developing a new area under irrigation the soil and water charachteristics must be checked and analysed and the selection of crops to be grown and irrigated must be considered accordingly.

It is very difficult both professiondly and economically to set up the proper lower or upper limits of soil, water and climatic charachteristics for optimal growth of commercial crops. The limits are usually set up arbitrarily, according to experiments and experience and farmers are advised on very careful irrigation management especially under the more adverse conditions.

With the expansion of citrus plantations also to the heavier soils, arbitrary limits for soil charachteristics were set and government loans were given only to plantations on soils which comply with these limits. Furthermore, careful irrigation management is being practiced in most of such groves to prevent water loging and root rot as a result.

The individual farmer or a group of farmers in their every day's work, face many and various problems of which irrigation as such is only a part and sometimes a very small part. The overall irrigation limitations described do not bother them to the same extent as they do the state, the various water agencies and the regional authorities. The actual daily irrigation problems which the responsible irrigator faces must be answered and worked out mostly during the course of the irrigation season itself. These actual daily irrigation problems can be listed as follows:

(a) Correct timing of irrigations
(b) Desired depth of wetting per each irrigation
(c) Amount of water required to wet a given depth of soil
(d) How to apply the required amount of water per each irrigation
(e) How to coordinate irrigation practices with other agricultural treatments
(f) How to overcome adverse soil, water and climatic conditions during the irrigation season.

In order that farmers will be able to answer the above requirements and solve irrigation field problems as far as field conditions permit, beforehand planning of water allocation and irrigation schedules should be attempted during the winter and early springs. Such systematic and thorough planning in advance, which takes all available information and previous experience into consideration, will largely facilitate the every day's and seasonal correct and efficient use of water. Farms have almost doubled their irrigated areas together with an increase in yields per unit area, without any increase in the total quantities of water, by correct planning and application of water.

An irrigation schedule of citrus is given here as an illustration of such, in advance planning:

The farm: Demonstration

The plot: Old citrus grove

Date of beginning of first irrigation: 15 April

Depth of layer: : - : - : - : Total available moisture at a depth of 0-100 cm

100% available moisture : : : :
m3/dunam/1cm depth : 1.4: 1.4: 1.4: 140 m3/dunam

Month	Lower limit of A.M. before irrig. %	depth of wetting cm.	100% A.M. at the depth of wetting m^3/d.	Daily (*) net addition m^3/d.	Intervals between irrigation days	Net amount of water per application m^3/d.	Irrigation No.	Irrigation date	gross (**) amount of water per application m^3/d.
Apr.	50	70	100	2.0	~~25~~	50	1	15/4	60
				2.5	25				
May	50	90	125	2.5	25	60	2	10/5	70
June	40-50	100	140	3.0	21	65	3	4/6	75
				3.5	21	65	4	25/6	75
July	40-50	100	140	4.0	20	70	5	16/7	80
Aug.	40-50	100	140	4.0	20	80	6	5/8	90
						80	7	25/8	90
Sept.	40-50	100	140	4.0	20	80	8	14/9	90
				2.5					
Oct.	40-50	90	125	2.5	25	60	9	9/10	70
						610		7000 m^3/Ha.	= 700

(* Daily net addition is the average daily amount of water actually added to the soil between successive irrigations.

(** Considering efficiency of irrigation at a rate of 85%.

The existing difference between the required amount of water to wet a given root depth and the applied amount, sometimes reaches 50% or more. For instance, instead of applying a net amount of 60 mm, the amount actually given can reach 900 m3/Ha.(90 m3/d.) and even then there is no guarantee that every spot in the irrigated area has received the required 60 mm.

Out of approx. 135.000 Ha (1350,000 d.) of the irrigated land in Israel, some 90% is irrigated by sprinkling. The following principal factors account for the fact that the method of sprinkler irrigation is so prevailing in this country:

(a) Sprinkling is usually the most efficient method of irrigation.

(b) The main development in agriculture in Israel has taken place during the last 15 years when sprinkler equipment of good quality was available.

(c) Sprinkler irrigation requires relatively little experience on the part of the irrigator and is adaptable to most topographical, soil and crop requirements and conditions.

(d) Sprinkler systems can be designed and constructed in a relatively short time.

(e) The topography of most irrigable land in Israel is rolling, therefore sprinkler systems which require little or no earth-work, are more suitable.

(f) Due to considerations of water distribution and metering, sprinkler systems are particurly suitable for small holder farms.

As a result of the extensive use of sprinkler irrigation throughout the country, the manufacturers of sprinkler irrigation equipment have specialized in this field, and by now all sprinkler equipment of good quality is being manufactured in Israel, both for local use as well as for export.

Whenever using sprinkler irrigation properly the amounts of water can be regulated and a high uniformity of distribution can be maintained. Under such condition application efficiencies of 75 - 85% can be achieved in practice. The gap between the required amount of water and the actual applied amount gets smaller every year due to better irrigation equipment which is being thoroughly tested before being issued into the market and due to better irrigation practice on the farm.

Conbined furrow and sprinkler irrigation systems are being practiced with success on increasing areas especially for cotton and corn irrigation. The labor requirements and the hard work involved in moving the portable sprinkler equipment in tall growing crops, call for improving the existing methods of irrigation and it is found that a combination of furrow and sprinkler irrigation is efficient in both respects as for as water use are concerned and labor. Usually the first two irrigations are applied by sprinkling and the rest, when the crop is fully grown, by furrows.

Most of the citrus and orchard irrigation in this country is irrigated by under-tree sprinkling. Recently, over the last two years, sprinkler systems with small diameter flexible plastic laterals have been introduced to a large extent into citrus groves and orchard plantations. There is a marked saving in labor and a better water distribution is accomplished with the use of such systems. The better quality of the plastic tubing is now emphasised in order to equal or surpass the life-time of the aluminium tubing used so far.

Mechanized sprinkler irrigation for low growing field crops has also been introduced in the last few years to increase the efficiency of irrigation labor.

A new method of sub-soil irrigation is being tried now in experimental and commercial plots with citrus and other fruit trees. If this method is proven successful as far as water distribution and salt accumulation are concerned the saving of water, as compared with overhead methods of irrigation, is said to amount to 30% or more.

The Israel Irrigation Field Service (I.I.F.S):

The Extension Authority of the Ministry of Agriculture maintains and operates 15 Irrigation Field Service Stations, cooperation on a 50 : 50 basis with all the agricultural District Councils throughout the country. Each Service Station consists of a staff of 3-6 field and laboratory workers and is equipped with a soil-water laboratory. The purpose of the I.F.S. is to assist farmers to improve irrigation practices and to conserve water while maintaining high crop yields. One of the duties of the I.F.S is to transfer to the farmers results obtained in the research stations and in the many controlled plots which the service field workers inspect closely throughout the growing season.

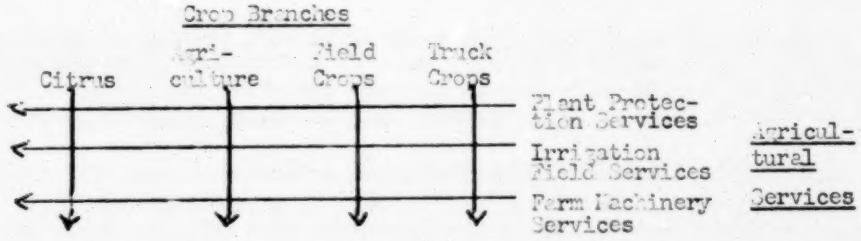
The I.F.S. is equipped to determine the pertinent soil and water characteristics of each farm, and use the information thus obtained in order to adapt the data produced by Research and checked in controlled plots, to the individual conditions of each farm. The I.F.S. has brought about the concept of irrigating according to soil, plant and climatic indicators with due regard to all other agricultural aspects. Each field worker

covers app. 2500 Ha, of irrigated land including all crops in private, cooperative and collective farms. The total cost of operating the I.F.S. in the districts is app. 10 I.L. per Ha., 50% out of which is shared by the farmers themselves through their District Councils and Agricultural Committees. Each of the I.F.S. stations has a district management consisting of representatives of the District Councils and Agricultural Committees and of representatives of the central and local staff of the I.F.S. The management assembles 2 - 3 times a year to draw the working schedules for the district I.F.S and to hear advance reports on the work done. The management also confirms the budget of the district I.F.S. at the beginning of each fiscal year and sees to it that the money is spent according to the endorsed budget. The organization of the I.F.S. is unique in this respect, since its budget is shared in equal parts by the government and the district councils.

The central staff of the I.F.S engages is specialized fields, namely: Orchard, Citrus and Field Crops irrigation, Sprinkler irrigation, Open irrigation, Soil and Water Problems and recently also in plant nutrition. At the central's staff disposal are a central laboratory equipped and able to perform all essential soil - water - plant tests and the Institute for Irrigation Methods and Equipment which carries out tests on newly developed irrigation methods and equipment.

The central staff of the I.F.S. carries out demonstrations and courses in the different subjects of irrigation and participates in demonstrations and courses of more general agricultural character. The main irrigation course is the course for Irrigation Technicians which lasts for over 3 months and is aimed mainly for irrigation supervisors in collective and cooperative farms. Three international seminars on irrigation were held by the central staff of the I.F.S. in cooperation with other research and water agancies and the F.A.O of the U.N.

The Irrigation Field Service is a part of the general Extension Authority of the Ministry of Agriculture and is one of its agricultural services which are given to farmers in all forms of settlements. The Extension Authority as such is composed of various branches, namely: Field Crops, Citrus, Orchards, Truck Crops etc. and agricultural services such as Plant Protection Service, Irrigation Field Service, Farm Machinery Service, Agricultural Economics etc. The interrelation between the branches and the services is best illustrated by the following diagram:



Since irrigation plays a major role in all crop branches and in the general economy of the individual farmers and the country as a whole; a great emphasis is put in the intensity of its service to the farmers. The I.F.S. is trying to utilize the best methods and equipment and use both local and world experience and knowledge, in order to render the best possible service. This can be achieved and is achieved only through the close cooperation with the farmers themselves and their representatives in the District Councils and in the Growers Associations.

The I.F.S. was established about 10 years ago in two districts only and has since spread to almost all districts in Israel. During its operation the I.F.S. helped to increase the efficiency of water use considerably and together with the farmers themselves and the general agricultural extension work which is carried out successfully in this country, has brought about an increase in crop yields per unit area and per unit water. And there is still much work ahead !

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